Partial and Iterative Lean Implementation: Two Case Studies

Abstract

Purpose of this paper	*This paper explores the implementation of lean within two contrasting UK based organizations; a food manufacturer and a healthcare organization. The different contexts provide insight to the strategic desire for efficiency gains and tactical issues and challenges of lean execution and implementation.*
Design / methodology / approach	*The research questions developed from the review of the literature were tested using evidence from field-based, action research within a food manufacturer and a National Health Service organization. The reported contrasting case studies contribute to the longer term debate on the adoption and adaptation of lean-based 'best practice' within organizations.*
Findings	*There are three primary findings: i) that the adoption of lean provides a strategic benefit, as well as providing a basis for a strategy of operational change; ii) that partial, as opposed to full, adoption of lean occurs due to external organizational constraints, such as demand patterns, supplier unreliability, little expertise in deploying change programmes, etc.; and iii) that a company will balance the adoption of the lean ideology against the financial costs and operational risks incurred in full adoption.*
Practical implications	*The conclusions drawn add substantially to the on-going commentaries on aspects of lean, and develop interesting questions for future research regards the developed 'Cycles of Lean Implementation' concept.*
What is original / value of paper	*The conclusion proposes that partial implementation of lean does not necessarily represent a conscious organizational choice, or any lack of conviction, but is representative of external constraints on the organization. This complements previous commentaries on appropriate strategies and develops interesting questions for future research into operational efficiency.*

Key Words: Lean implementation, case study research, food sector, healthcare sector

Paper Type: Research paper / Case Study

1. Introduction

In this paper it is argued that partial and iterative implementation of the lean philosophy, as opposed to its full adoption, does not represent a conscious organizational choice, but is representative of progressive changes that an organization makes in response to external pressures to improve operational performance. This offers an alternative view to that represented in the current literature where lean remains favourably regarded and the benefits following implementation make the philosophy very hard to challenge. A more critical reflection of the literature signals some deficiencies in our current understanding. The issue is that the literature advocates "full" adoption of lean, whereas empirical evidence indicates more patchy, piecemeal and (what we call here) partial adoption. The problem is, therefore, that without investigating the phenomena of partial and iterative lean adoption, further development and improvements in relevant techniques

will be hard to establish. As lean encapsulates a number of sound best practice operational techniques, these techniques will logically be implemented where they offer organizational benefits. The findings from the research conducted for this paper indicates that techniques used by the case organizations are best described as 'unconscious' lean implementation. This represents an idea unaccounted for within the literature, but addressed here with a critical review of the literature supplemented by empirical evidence from two contrasting cases.

Despite a large body of literature there continues to be wide variations in opinion of what Lean/Just-In-Time (JIT) comprises (Ward and Zhou, 2006; Holweg, 2007; Gupta and Snyder, 2009; Moyano-Fuentes and Sacristan-Diaz, 2012) and the set of prescribed techniques used to achieve the stated benefits (reduction of inventory within the process, improved cash flow, etc.). This is further confused when the associated (but markedly distinctive) concept of agility is discussed (Inman *et al*, 2011; Naim and Gosling, 2011). There are two main contrasting views amongst academics concerning lean implementation. Traditionally the view is that both the philosophy behind lean and the JIT techniques used to implement it must be simultaneously adopted to ensure the full benefits accrue to the organization (see, for example, Im and Lee, 1989; Lieberman, 1989; Srinidhi and Tayi, 2004; Yasin *et al*, 2004; White *et al*, 2009). However many techniques developed in downstream assembly industries (e.g. kanban and the right to stop production if there is an error, etc.) are difficult to implement in some types of operation, such as upstream continuous processing industries or complex transactional processes. It is argued here that organizations will partially adopt the lean philosophy and a package of relevant techniques to positively improve the effectiveness of their value streams dependent upon specific situations (see Soriano-Meier and Forrester, 2002; Mistry, 2005; Papadopoulou & Özbayrak, 2005; Salaheldin, 2005; Fiedler *et al*, 1993).

These two views, full versus partial adoption of lean, raise a key question that forms the focus for this paper: Does partial implementation represent deterioration and dilution of the true philosophy behind lean, and therefore its operational impact? This paper explores this question using a combination of existing literature and reference to two case studies of organisations that set-out to implement lean. The first case is the UK subsidiary of a large British multinational (hereafter called the "Company"), a multi-site, blue chip, food processing company; the second case is a National Health Service (NHS) organization (a former ‘Primary Care Trust’) seeking

to improve its premises construction process. Both the Company and the Healthcare organization sought to implement lean principles and techniques. Following the literature review, an outline of the research methodology is presented, before the case findings are highlighted, followed by a discussion of these. Finally conclusions and implications are presented.

2. The Literature

Lean came to prominence in the Western academic literature during the mid-1980s as a result of the increased curiosity surrounding the "secret" of practical Japanese manufacturing techniques and the Toyota Production System in particular (Pegels, 1984:3). The literature was spurred-on by cases of practical application which dispelled the myth of JIT as a secret or magical technique, but also promoted ways and means to replace more traditional "push-type" manufacturing planning and control systems with lower inventory, faster throughput and more efficient market/demand "pull" systems (Demeter and Matyusz, 2011; Ertay, 1998). This represented a change in manufacturing paradigm from mass production (O′Neill and Sackett, 1994) and was the basis for the emergence of the lean production paradigm following the publication of Womack *et al*'s 1990 seminal lean production thesis *The Machine That Changed the World*. Very soon it was accepted that lean simply represented "best practice" in contemporary manufacturing operations.

In recent years the volume of JIT-specific literature declined in favour of the more holistic concept of lean manufacturing (Papadopoulou and Özbayrak, 2005) and the broader notions of lean thinking (Womack and Jones, 2003). Harrison and Van (2002:171) state that lean thinking is a "cyclical way to chase perfection by removing waste and improving value from the customer perspective". The point of improving aspects of perceived value was echoed by David and Eben-Cheime (2003) in their work on how far should JIT vendor-buyer relationships go.

It provides advantages such as reduced lead times, improved work routines, better teamwork, employee empowerment, quality improvements and lower costs. The five widely accepted principles when establishing lean thinking as shown in Figure 1: i) identification of customer value; ii) management of the value system; iii) developing a flow production; iv) using the 'pull' technique; v) striving for perfection. This shift in focus has been advantageous in that Japanese-inspired lean manufacturing techniques are now seen within a broader strategic context. But this

has taken attention away from the basic techniques of JIT and the management of mate rials and resources at the shop floor level, which has never been extensively developed in upstream process-type industries. Moreover, lean thinking has also been implemented within transactional, healthcare and construction processes (Arnheiter, Maleyeff, 2005; Cuatrecasas Arbos, 2002; Kollberg et al, 2006; and Kagioglou and Tzortzopoulos, 2010). This paper therefore focuses specifically on the operationalization of lean principles and techniques in a process operations context.

Many authors argue that JIT and lean are only truly applicable to large scale production, for example, Gurumurthy and Kodali (2011:450) identified that "there are few [lean] case studies applied to the category of project or continuous production, whereas the publications of lean thinking in the mass production category is substantial", though Bennett and Forrester (1994) argue that JIT and lean adaption is relevant and beneficial for low volume, high variety producers, an argument backed by Soriano-Meier and Forrester (2002) in their study of partial lean adoption in craft-based industries such as ceramics production. To support this argument many lean applications in complex and low volume transactional and construction processes have taken place successfully (George, 2003). Interestingly there is evidence of the use of lean within the construction industry for about 20 years (Koskela, 1992; Howell and Ballard, 1998; Macomber and Howell, 2003). Both the International Group for Lean Construction (IGLC) founded in 1993 and the Lean Construction Institute (LCI) founded in 1997 work to develop knowledge and adapt lean thinking within the design, engineering, and construction of capital facilities (http://www.leanconstruction.org/ and http://iglc.net/). This has been consolidated within the United Kingdom (UK) following the work of Egan (1998) "Rethinking Construction".

However, successful lean implementation is strongly linked with its adaptability to fit a particular setting and work environment influenced by cultural, methodological and communicational elements (c.f. Inman et al, 2011; Losonci *et al*, 2011; Khurrum, et al, 2013). Lean is environmentally dependent and can generate great benefits only when appropriately applied, which does rather lead to considering lean as a pragmatic programme rather than dogmatic. It has been demonstrated that lean manufacturing is not directly applicable to every single process, but needs to be transformed and tailored to fit a particular environment (Bamford, 2011; Khurrum *et al*, 2013).

Moving on from definitions and discussions on the application of lean, and the general acceptance of its desirability, the question arises of implementation – how to introduce and sustain lean operations. Is there a "best" way to implement lean? Is there a "best fit" solution for implementation? Safayeni *et al* (1991:28) argued there are three key motivations behind implementing lean: i) the need for key performance indicator information on accomplishments; ii) the 'fashionableness' of the idea; and iii) external pressures on suppliers from customers to implement lean and JIT-pull. This ties-in with the findings of Bamford and Forrester (2003) who studied external influences and the reasons for organizational change in an operations context.

The large body of literature on the "success" of lean indicates almost undisputed agreement on the beneficial impact of intelligent lean implementation is almost undisputed (see, for example, Vokurka and Lummus, 2000; Salvador *et al*, 2001; Srinidhi and Tayi, 2004; Thun *et al*, 2010; Singh and Singh, 2013). There are some counter arguments to this; Beard and Butler (2000) conversely argue that not all organizations are suitable for lean systems and its adoption must fit with business needs and practical realities. There are also critical reflections on the adoption of lean in the context of health service operations (relevant to Case 2 in this paper) where, for example, Radnor and Walley (2008) and then Radnor *et al* (2012) argue that the health sector jumped at the attractive notion of lean, but failed to fully grasp its philosophy and the set of tools to fully implement it – hence resulting in disappointing returns and much scepticism. Nonetheless Harber *et al* (1990) show that lean can reward organizations with some form of benefits as many of the techniques are based upon sound operational principles.

The work of Safayeni *et al* (1991) is useful here in providing a relevant conceptual model; they discuss the issues of implementation and classify company efforts towards lean into four levels: i) education; ii) pilot project; iii) modified; and iv) total (see Figure 2). These form a continuum from minimal to maximum implementation and therefore indicate grades of partial (levels i, ii, iii) to total (level iv) adoption. Each level is a discrete category representing a general state with respect to implementation in an organization. They argue that lean can be implemented at a variety of levels, but recognise the difficulties in progressing from level to level. They argue that "partial implementation may be seen by the management of an organization as a reasonable choice since it provides an opportunity to explore the ideas of JIT and lean without changing the overall

organizational structure" (Safayeni *et al*, 1991:34). They define total implementation as rare in organisation and that the major characteristic is a structure along product lines (self-contained, semi-autonomous units). Total implementation could be linked with what is called today, operations excellence. Organisations achieving this stage are potentially rewarded with well-known quality awards and prizes, such as EFQM, Malcolm Baldrige and Shingo).

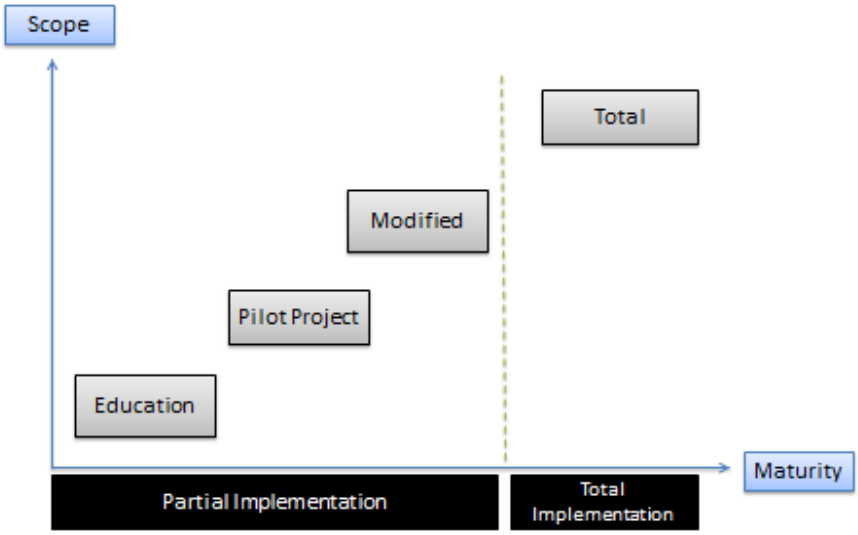

Figure 2: Partial Lean Implementation Model (Safayeni *et al*, 1991)

Harber *et al* (1990) argue that a firm will choose a suitable point along this type of continuum, depending upon their willingness and ability to invest in lean and the timescales involved regards payback. Yang *et al* (2011) and Sohal *et al* (1993) agree that any move towards lean will yield short term goals, and that individual companies will approach the quest for better performance and increased competitiveness in a way that is achievable for these organizations.

Fiedler *et al* (1993) took a different perspective in their analysis of lean implementation. They argued that, due to the complexity of the methods involved, the myriad of JIT and broader lean techniques cannot all be implemented at once. It is therefore impossible to specify a sequence of well-defined steps for lean implementation in any particular case. More recently White *et al* (2009) in an interesting study investigated the holistic implementation of just-in-time and suggested a correct sequence for implementation, in the order: i) conformance to

quality related practices; ii) delivery reliability related practices; iii) volume flexibility related practices; and iv) low cost related practices. They argued that significant improvement in operational performance, as reflected in a reduction of "non-value added" performance, should be achieved via the cumulative capability building that this sequence created. This was also reinforced by Yang *et al* (2011) in their paper on the impact of lean on business performance.

From a financial perspective, both Boyd *et al* (2002) and Klingenberg *et al* (2013) warn that companies should exercise caution in the implementation of lean. They suggest that, whereas lean has been successful as an inventory reduction tool, lean systems do not automatically increase profitability. Costs of implementation and redesign, including training, capital expenditures for reengineering and increased frequency of transportation need to be set against the benefits. It is only in the long-term, once initial costs have been paid back, that positive returns might accrue.

Olhager and West (2002) argue that lean is, principally, a system for linking together and improving the collective efficiency of operations (or transactional processes) units and the tiers of supply through the value chain; or as Frohlich and Westbrook (2001) define it, the arcs of integration. At its heart lean operates in a 'pull' mode and is by definition dynamic. Buvik and Halskau (2001) highlight that, whilst this is the case, there is a trade-off between improvements in the efficiency of the value chain and the dependence and fragility of inter-firm relations. Brandenburg and Ellinger (2003:309) provide a useful review of work organization and human resource development issues, saying that "lean learning" can be "conceived as anywhere, anytime, anyhow learning that is just enough, just for me, and just in time". This enables employees to challenge the way in which their companies operate, and the means of developing lean competencies.

From the above it appears that lean adoption offers a strong framework for organizational change, due to its flexibility and adaptation to different contexts and needs. Lean is best implemented as a progression (Fiedler *et al*, 1993; Salaheldin, 2005, Papadopoulou & Özbayrak, 2005; White *et al*, 2009) rather than once-for-all total adoption (Srinidhi and Tayi, 2004; Yasin *et al*, 2004, Im and Lee, 1989; Lieberman, 1989). Lean has multi-faceted application within organizations. From the literature there are three principal uses of lean in a strategic sense: i) to gain a strategic competitive advantage; ii) to improve operational efficiency; and iii) the provision of a framework to implement a change strategy.

3. Research Design and Methodology

3.1 Research questions

Further study of partial and iterative (defined here as repeated application) lean adoption is needed so as to help in the further refinement of relevant lean techniques. In conducting this research we wanted to explore whether the usage of these techniques are often 'unconscious' adoptions. Using the above literature review as a base, three research questions (RQs) emerged: i) There is a lack of evidence for how effective lean techniques are in obtaining specific strategic objectives outside of the philosophy itself. So RQ1 = how does a company use the ideology to achieve their strategic objectives?; ii) Mistry (2005), Papadopoulou & Özbayrak (2005), Salaheldin (2005) and Fiedler *et al* (1993) state the lean philosophy can be implemented in stages according to the requirements of the organization, whereas others (including Srinidhi and Tayi, 2004, Yasin *et al*, 2004, Im and Lee, 1989, and Lieberman, 1989) believe that for lean adoption to be successful, then full implementation is necessary. This helps to explore whether a partial implementation of lean is sufficient, or whether such attempts only serve to undermine the very philosophy behind the concept? So RQ2 = is partial implementation representative of a deterioration of the true philosophy behind lean and its operational impact? For the purpose of this research we have adopted the definition of partial from Safayeni *et al*, 1991, as levels i, ii, iii from their Lean Implementation Model (i = education; ii = pilot project; iii = modified). And iii) It may be that organizations believe it is not possible to impose the 'entire' lean philosophy (as propounded by Voss and Harrison, 1987), and in doing so are not reaching full potential. Alternatively it is feasible that, in implementing some of the techniques synonymous with lean, they are utilizing the techniques unconsciously as part of "best practice". So, RQ3 = Does partial adoption of the lean philosophy inhibit the potential of the company?

The two cases comprise a contemporary manufacturing company seeking to adopt lean principles in an attempt to improve the efficiency and effectiveness of its operations, and a healthcare organization seeking to enhance both the speed and quality of its infrastructure development (construction) processes (the planning and design processes that the organization must consistently undertake to construct new infrastructure). Before we go to the cases, it is essential to present and reflect upon the methodology used in this study.

3.2 Research context

This paper explores the implementation of lean within two contrasting UK based organizations; a food manufacturer and a healthcare organization within the UK National Health Service (NHS). The different contexts are utilized to provide insight to the strategic desire for efficiency gains and the more tactical issues and challenges of execution and implementation. The case studies contribute to the longer term debate on the adoption and adaptation of lean-based 'best practice' within organizations, as called for by Moyano-Fuentes and Sacristan-Diaz in their 2012 review of lean research, in which they suggested more research in different contexts, both in terms of sector and geographical, would make a defined contribution.

3.3 Research method

The research questions were tested using evidence from field-based, action research, within a food manufacturer and an NHS organization hybrid process (construction/transactional). Gaining access to organizations for this type of longitudinal research can be difficult, and is granted through a combination of good luck, effective planning and/or hard work (Bryman and Bell, 2007). The first research case, within the food manufacturer, comprised two stages over a 15 month period: i) three months of primary research using action research intervention; ii) participant observation with small scale interventions, reviews of documentation and a schedule of semi-structured interviews with key personnel. One of the authors was employed for a three month internship in an operations improvement role and from this the opportunity for more extended research originated. The core investigation involved an examination of inventory management practices with the objectives to investigate wastage, then recommend and implement a method for waste reduction. Other academic partners were closely involved and provided direct supervision and professional guidance throughout. Three months on-site, coupled with wide-ranging follow-up research over the subsequent next 12 months, allowed for extensive participant observation (multiple production and improvement meetings), small scale intervention, and reviews of internal documentation. Semi-structured open-ended interviews with 34 people (eight senior managers, nine middle managers and seventeen operators) were conducted to elicit information based upon categories identifying the important elements of lean/partial lean adoption defined from the

literature survey. There were also a large number of subsequent follow-up conversations with many of these interviewees, which provided a rich data set. All the main staff functions employed by the Company were represented and the interviewees were selected using a combination of judgment, snowball and quota techniques (Remenyi *et al*, 1998). Manual thematic coding of the data sets (as proposed by Alvesson and Deetz, 2000) was carried out in the analysis of the primary and secondary research information.

The second research case, within a healthcare organization in the North of England, involved five phases over two years: i) Needs Analysis; ii) Review Current infrastructure Development Procedures; iii) Establish Current Baseline of Performance in term of cycle time and number of rework to meet stakeholders requirements; iv) Establish Best Practice in infrastructure, Facilities Planning and Execution; v) Test, adapt and implement approved models. This two year project employed one of the authors and enabled the participation in a 'construction' lean implementation initiative. An academic partner was closely involved and provided supervision and guidance during the participant observation and intervention period. Extensive direct access was provided; full reviews of internal documentation; the application of semi-structured, open-ended interviewing to elicit information based upon categories defined from the literature review; follow-up conversations with many interviewees. The research directly involved more than 30 participants, with a core operational team of seven members as well as four senior managers, five estates managers and analysts, three primary care managers, three service development managers, one finance manager, five external experts, and a cross-functional strategic committee group of between 10 to 15 (the actual number fluctuated during the research). They were observed, formally interviewed and worked with during the research period. Furthermore, multiple teams and user groups were indirectly involved during all stages of collation, design, intervention and implementation.

In devising the research we were keen to abide with the principles set out by Moore (1986) who states that, to be properly regarded as action research, a project must contain a continuous thread of objective evaluation and a mechanism whereby the results of the evaluation and lessons learned during the project are fed back into the process. Thus research and practice observed becomes dynamic and constantly modified in the light of experience. The distinguishing feature of action research, and our research specifically, is that it integrated real, practical value into the

organizations as well as providing a rich vein of qualitative data. Action research is emergent and the research process takes place gradually. Its cyclic nature helps responsiveness and provides rigour and validation (Dick, 2000). One weakness of the adopted research methodology is its very public nature. If the project did not produce tangible real-time results, those supporting it may lose interest and bias any future initiatives. Another limitation is the two cases approach, and the perennially argued issue of the restricted generalisability of the findings. However Remenyi *et al* (1998:113) suggest this can be enough to add to the body of knowledge if the study is comprehensive enough with a longitudinal dimension. The triangulations in our research, in the forms of organizations documentation, participant observation, informal interviews and, perhaps most importantly, direct interventions, were all used to provide depth and robustness to the research.

4. Findings

For clarity, the findings from the action research interventions have been split to provide detail for Case One and Case Two respectively.

4.1 Case One – The Food Company

The Company is part of an integrated food business and the case analysis is set within the food processing industry, mostly comprising continuous process operations. It markets, manufactures and distributes a broad range of food products in the U.K., Ireland and France. The Company has over 50 manufacturing sites, employs 20,000 people, and enjoys total sales of approximately £1.5 billion per year. It is divided into three core businesses; Bread Bakeries, Consumer Brands and Customer Solutions. All three sectors have specific business strategies to address market and corporate objectives in their own markets. The Company has two main manufacturing plants located in the U.K., Site One and Site Two. The food Company was selected as it portrays the features the researchers were looking for – process type operations – with deliberate attempts to adopt lean wherever this made business sense. The food and drink (F&D) industry has five distinctive characteristics (Bolseth and Alfnes, 2009:1):

1. Low complexity. F&D products are often standard products consisting of few components/ingredients.
2. Low margins and high volume. F&D manufactures are forced to accept low prices to keep their share of the market. Food products are typically high-volume products produced with low margins.

3. Perishability. Raw materials, semi-final products and the final products are perishable and have limited durability (between 1 day to 2 weeks for many products).
4. Availability is crucial. Customers buy substitutes if a product not is available on the shelf.
5. Packing is an important element of food products. The packing serves two purposes: it protects the product from the surroundings, such as sun, heat, cold, air, etc.; and determines how the product appears to customers, as a crucial part of marketing effort.

4.1.1 Site One

Site One operated as a 'dry' site, meaning all products produced and packaged are powder or crystal based. Initial issues at the site included a bottleneck created by the packing lines; the age of machinery (mostly over 20 years) running at only 60 per cent efficiency and costing £794,000 per year to maintain; and unreliable and inflexible lines, creating a finished goods stock of 2.7 weeks costing £1,620,000 in working capital per year. The packing operation had very limited flexibility and only limited ability to support product variety and brand management in a competitive market. The key motivation for the lean operational improvements was the discontinuity between the manufacturing potential and the packing capabilities. An important consideration was that all capital investments had to pay back within two years. This was to be achieved through increased efficiencies, reduced finished goods stocks, greater flexibility and reduced shift working, all key facets in the ideas of lean manufacturing.

The management-driven initial lean improvements included the relocation of packing lines into more user-efficient modules (cells) which could be managed by a single operator. Relocating the new equipment into 'U-shaped' layouts enabled a single operative to attend to a greater proportion of the line. This restructuring of the layout and flow increased both operational efficiency through the use of newer equipment and a 6.5 per cent reduction in labour costs. Additionally key lean recommendations were adhered to, including the close placement of workstations together so inventory could not build-up, the use of U-shaped lines so staff can move between workstations to balance capacity, and transparent material flow through all parts of the plant. Whilst managers recognized the new proposed layout appropriate for factory space utilization, they were also meeting the criteria for lean manufacturing principles on layout and flow.

As well as undertaking an operations overhaul, the Company viewed the lean modernization of the packing lines as a chance to improve staffing policies and

motivation, introducing lean's 'basic working practices'. The review of machinery meant individual operatives would man a broader spectrum of roles simultaneously. Where previously an individual looked after a single machine on multiple lines, workers now looked after a number of machines on a single, U-shaped line. Another lean working practice, 'autonomy', encouraged the delegation of responsibility for production and quality to people involved in the direct activities of the business. Shop floor operatives were given the responsibility to stop the line if need be and encouraged to take part in problem-solving sessions.

The overhaul of the packing process dramatically improved flexibility and reliability. The main achievement was that inventory levels of finished goods were reduced from 2.7 weeks to seven days, a working capital reduction of £600,000. Table I summarizes the key findings from Site One.

Site One (Dry)	**Findings**
Waste Reduction	Increased operational efficiency and employee involvement reduced stock from 2.7 weeks to 7 days resulting in a working capital reduction of £600,000
Restructuring of Layout and Flow	Use of U-shaped lines meant staff could move easily between machines, producing a 6.5 per cent reduction in labour costs
Adoption of Basic Working Practices	Encouraging employee responsibility, autonomy and participation in problem solving

Table I: Summary of key findings from site one

4.1.2 Site Two

Site Two is referred to as a 'wet site' as all products are liquid, filled into glass jars for distribution. The site is divided into two key departments: sauces and preserves. The variety of products made in preserves, combined with production alterations, made this process the focus for improvement. There were three principal causes of high inventory and waste within the department: start-up problems, machine breakdowns, and production reliability issues.

The lean improvements at Site Two comprised four key actions: i) investment in new equipment; ii) implementation of action teams; iii) a drive towards stock reduction; and iv) the trial use of the Kanban control system. Regarding i) two million pounds sterling was spent on new equipment. The Company required a payback of two years (a business prerequisite) through investment in new automated equipment, which translated into a need to reduce wastage by at least five per cent and

develop a more flexible, leaner, manufacturing system producing smaller batches, with less disruption to the process.

For ii) a number of lean action teams were formed. These teams helped to highlight causes of downtime, provided potential resolutions, trialled these and, where successful, implement the new solutions. The teams consisted of a range of employees (managerial to shop-floor) and included engineers to provide technical expertise. For example, Action Team A was set-up to assess the continued issue of jar breakages on lines three and four. Following observations and trials, the team facilitated improvements to two production lines, lines 3 and 4. On line 3 this reduced daily downtime from forty minutes per day to five, an 87 per cent improvement. On line four, downtime was reduced, over a seven week period, from 500 minutes per week to 200, a 60 per cent improvement. Action Team B was formed to assess recurring problems in the process that placed trays on pallets, then wraps them for distribution. The breakdown levels presented a significant operational inefficiency (on average, 5 days a month were lost). By creating a more robust system of control through the palletization process, the team decreased downtime by 80 per cent and was highly praised by senior management for their achievement. Posters illustrating their success were placed around the whole site to communicate the good news.

Regarding iii) the Drive Towards Stock Reduction, Site Two's focus on lean continuous improvement facilitated a reduction in stock held and work-in-progress (WIP) down to just seven days. As a consequence of this 'stream-lining' the Company closed three warehouses and consolidated its logistics activities. This resulted in 90 people being made redundant from a total workforce of 450; not well received by the workforce, but a significant saving in unnecessary and non-value-adding work.

Finally iv), the Trial Use of Kanban. Within one manufacturing division the introduction of Kanban control facilitated a more pre-emptive approach to production. Raw materials were now only brought into the warehouse and prepared if signalled or triggered from further down the packing lines. The system was particularly effective in this area; the production lead time was minimal, so control could be exerted, and wastage was effectively eliminated. With such a level of success why had Kanban not been implemented on a larger scale throughout the preserves department? Managers desire to progress towards lean manufacturing was frustrated by external factors, primarily the key suppliers failing to reliably deliver on time, quality and quantity.

Not all concerned saw the move towards greater involvement as a positive step. Whilst some employees were keen to contribute and gain recognition for their efforts, others were not: "*I'm paid to run the line, if they want me to run the company, they'll have to pay me more!*" (Shop Floor Operator). This underlying message was apparent elsewhere in the plant: employees were expected to contribute more and more, but no monetary reward was forthcoming, enthusiasm rapidly faded. Table II summarizes the key findings from Site Two.

Site Two (Wet)	**Findings**
£2 million machinery overhaul	£2 million Investment repaid over two year period
Use of Action Teams	Two teams achieved 60 per cent downtime reduction over a seven week period, and an 85 per cent downtime reduction over six working periods
Elimination of Waste	A number of initiatives (mentioned above) facilitated a 40 per cent fall in total wastage
Reduction of Stock being held	Reduced stock holding to seven days, in line with other areas of the Company
Reduction of Work in Progress	Efforts to adopt this technique hindered by external factors such as supplier unreliability and the use of fresh produce
Kanban Control system	Use in the mincemeat department facilitated a pre-emptive approach, with a reduction in wastage of 70 per cent per
Human Resource Policies	Management appeared to fully support the philosophy as a means of facilitating operational efficiency. Senior management were restructured to support the change strategy. Shop floor operatives however, appeared less well informed of the transition, and as a direct consequence reluctant (or in some instances scared) to participate

Table II: Summary of key findings from site two

Table III presents the key themes and specific issues that emerged from the interview process.

Food Company	**Observations**
Lean Motivation	• Key motivation for the lean improvements was the discontinuity between the manufacturing potential and the packing capabilities (capacity constrained packing lines with a high break down rate). • The motivation to employ lean techniques was said to be because the techniques made sound operational sense and that 'many' organizations used the philosophy

Lean Expectations	• The key motivation and expectations were stated to be supply driven:
	  • To reduce the number of shifts required for the same output (improved efficiency and faster changeovers through new equipment)
	  • Using modern packing equipment to: reduce finished good stocks through more dependable lines; create greater flexibility with smaller runs without causing disruption; supply would be more reliable with less need to rely on inventory

Start-up problems	• There appeared to be a high level of apathy on the part of the operators, who tended to rely on experience and sign-off the start-up sheets as a 'thing to be done' rather than an indication of thorough completion. This often caused issues regards production scheduling and consequent re-scheduling.
High machine	• Despite having engineers available, all with over 5 years of experience, and 76%

breakdown levels	with formal engineering qualifications, their ability to address machine problems on an ad hoc basis was debatable, due to breadth and variety of problems experienced • The level of machine breakdown presents itself as a serious constraint on operational efficiency, as evidenced by historical shift reports
Production based issues	• There were significant discrepancies between the planned levels of production, recorded resource usage, and actual handling of materials. Multiple reasons were given for this but the clearest = the planned manufacturer of 250 batches recorded a usage of 250 batches of standard measures. Actual production used the resources for 260 batches which equals a loss of £100 in sugar alone. The figure escalates to 25 times this (£2500) in one week
The lean philosophy?	• There was a very strong view that the Company was based on years of developed operational practice, and as a result change must be incremental and could not happen "overnight". • It was hoped that the Company would "one day" operate a "pull system of control" • sound operational practices were considered key, not merely "Lean or Just-In-Time techniques"
Outcomes	• There was a level of surprise amongst both management and workers to the lack of outright objections by shop floor staff • One employee saw her role as "far less boring and more enjoyable" • Overall the Lean project was considered to have been delivered as planned, and with measureable operational and financial success

Table III: Case One – The Food Company: Key Emergent Themes

The Company realized operational benefits in using certain lean techniques to improve efficiency and performance. It strategically used parts of the philosophy to its benefit, whilst operating within certain limitations. Tables I, II and III have summarized the key findings.

4.2 Case Two - The Healthcare Organisation

This case concerns lean implementation within a UK based National Health Service (NHS) organization (former Primary Care Trust), which sought to 'lean' its infrastructure/construction development process, focusing on speeding-up the cycle time and improving the infrastructure quality, defined as the fitness for purpose (the process being here the infrastructure/construction development: planning, design and construction). The healthcare organization was responsible for delivering the health services to the local community and over 500,000 people have access to these services. Its strategy was to address the local health inequalities and improve the quality of the services. One of the main resources to deploy this strategy and achieve these goals is through modern and 'fit for purpose' premises, the interface for delivering services to the community. The organization realized that efficiency improvements were required to speed-up the development process of its premises, by

implementing lean. Analysis indicated it took up to 12 years from premises planning to construction, which often resulted in a lack of fitness for purpose of the premises. They no longer met the customers' (both clinicians' and patients') requirements and expectations. Based on data from 30 construction projects 7.5 years was the average to premises completion. Three distinctive phases emerged: i) Planning, 4 years on average; ii) Design, 2.5 years; and iii) Construction, 1 year. No clear correlation was established between the size and the length of the project and it was observed that the variations within the cycle time were extremely high and difficult to estimate. New premises were deemed strategic and crucial for this organization and senior management decided to introduce lean techniques to plan, control and improve the process. They sought to reduce waste, non-value added activities, generate efficiencies and set-up continuous improvement activities.

The healthcare organization managed 56 buildings, which had "a net book value of £41,428,850 and the capital charges and depreciation costs were £8,501,750 in 2008/09" (CIAMS, 2010:10). However, this network did not satisfy the local demand and provide a modern interface supporting the future healthcare provision model (a flexible and community integrated healthcare system). It therefore needed to re-build several premises within a five year period. Nine schemes were identified by the Board of Directors as priority developments; these were based on the inequalities and healthcare services discrepancies between the different districts and aimed to modernize and re-design the healthcare network. To achieve this £37.5 Million capital investment was budgeted, an average £4.1 Million per development (CIAMS, 2010). Within this case context there are three core characteristics: i) the high complexity: "…*the planning and design of healthcare infrastructure needs to consider the political, environmental, legal, financial constraints and meet the strategic objectives set locally and nationally"* (Senior Directors, interviews conducted in 2010 and 2011). These contextual constraints also caused long cycle (build) times and high variations (i.e.: from the data gathered Min(cycle time) = 3.5 year, Max(cycle time) =12 years); ii) the bespoke aspect: both the process and the output were bespoke and unique; the standardization of all operations was not always achievable; iii) the low volume and long cycle time: the infrastructure development required a long cycle time, hence all the benefits from implementing lean would require patience and consistency.

From the organization process assessment and analysis, it was established that Decision Making operations were the main bottleneck activities of the premises planning and design processes. An Estates manager described *"…decision making is too bureaucratic [...] which has been one of the major frustrations in the development and construction of new infrastructure".* Another senior premises project manager said *"We need to make sure we have got all the decision makers around the table right from the start and that we get full buy-in from them regarding a specific project. They need to understand the implications on the development process for not making sound decisions"*. He continued *"if the stakeholders have six decisions to make and one of them is on the critical path, i.e.: site selection, we don't want to be wasting time doing the others things when we have got to make that decision"*. These frustrations and inefficiencies were due to multiple organizational silo structures, and complex process implications leading to a lack of transparency for the stakeholders and the public. The lack of process ownership perceived by the cross-functional team members, and the lack of evidence based processes to reach rational choices, were issues that emerged. With the inputs (datasets, information and knowledge, and expertise) available to the premises programme teams, the decision making was not seamless, the operations delivery was lagging and it stalled the development and construction process. This went some way towards explaining the long cycle times. For instance, the selection of the site could take as long as two years. Moreover, these operations were high value added activities as they engaged with the local population and had long term consequences. Therefore, these bottleneck activities needed be optimized e.g. deciding scheme development priorities, identifying best location for sites, defining optimum size and most appropriate service portfolio. All these were complex decisions and processes needed to be improved to gain efficiencies and lean effectiveness in the overall process. These operations directly supported the business cases and the 'customer' requirements, which were crucial process outputs and milestones; all ultimately aimed at obtaining final financial go-head, as demonstrated by Figure 3.

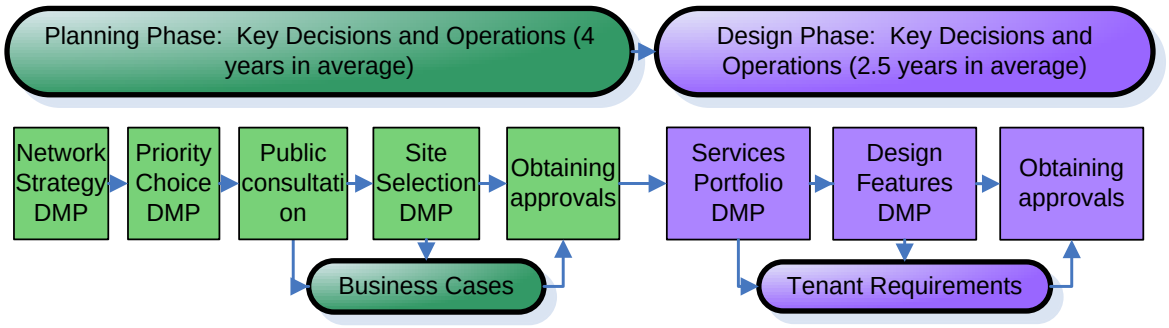

Figure 3: Key process operations during the planning and design of infrastructure

(Note that DMP=Decision Making Process)

These operational decisions were made by the team over several months using available information - initial lean improvements were made by implementing evidence based decision making models, such as Multiple Criteria Decision Analysis (MCDA). This aimed to inform prioritization of developments, to optimize the network rationalization and to optimize the locations for new developments against defined objective criteria. By engaging with stakeholders to build and resolve these Multiple Criteria Decision issues, the organization speeded-up the planning process by 18%. The decision making models allowed site selection with public consultation within 3 months; adding value through highly transparent and more rational consensus. It was also noticed that these methods improved the quality of the data gathered from different sources during the public consultations, such as the 'voice of the population' and their quantitative assessment of the alternatives. The models were deployed and tested using Intelligence Decision Software (IDS) to optimize the analysis and the results (Dehe *et al*, 2011). This also helped to organize and focus the quantity of data that needed to be collected during the public consultation, the central activity in the planning process. All of these lean project activities reduced the waste, speeded-up the process and defined what represented 'value' for the local population (inclusive process and transparent outcomes) – all key aspects of lean thinking. Furthermore, these implemented models became a baseline for other decision operations, with adjustments made to adapt to the specific decision situation – e.g. in a manufacturing environment this is associated with setting-up the machine for processing new batches based on the customers' requirements (c.f. David and Eben-Cheime, 2003).

In the design phase, where interactions with external suppliers and customer had to take place, inefficiencies were highlighted. One of the managers reported the following when asked where the main problem was: "*... in the design process, the estates department must make sure to get the right sort of building and components within the building for clinicians to be able to provide service. But in my experience lots of clinicians find it difficult to visualise and conceptualise how they are actually going to work. So ... an estates department does need to add value and improve in liaising what in effect is the client needs, and the builders understanding and capabilities in producing the building"*. Traditionally, the design phase suffered from a high amount of rework and change, leading to long lead-times and a lack of fitness for purpose of the final product. One of the reasons for this was the lack of transparent mechanisms and frameworks available to the team managing the projects. Moreover, the design of the infrastructure, and the design of operations and services were not synchronized which led to wastage and rework. With the introduction of another associated lean technique, Quality Function Deployment (QFD), information regarding the design was shared transparently for all decision makers and process operators. They could identify possible dysfunctionalities earlier in the design process and resolve them before they became 'issues'. Furthermore, this helped to link the phases' transitions by reducing the waste at the end of the planning phase, as in a supply chain one wants to minimize the disruption caused during offloading operations. It was found that QFD also led to improved process ownership and encouraged cross functional problem solving activities. Finally, in order to reinforce the lean implementation, it was necessary to clearly monitor and control the operations and outputs, and to learn from them. The deployment of a measurement framework associated with internal and external benchmarking activities was used as a means to reinforce continuous improvement actions.

In summary, by introducing these associated lean techniques a framework for streamlining the premises construction process (reducing waste and setting-up continuous improvement activities within the planning and design of new premises) respecting the complex environment was created. This lean implementation supported a cycle time reduction of 18% and the planning and design costs reduced by 6.5%. This led to an average planning and design cycle time of 5.33 years and saved up to £270,000 per scheme, a total of £2,430,000. It is believed that lean thinking can still be fully deployed in the construction industry and its related processes; a good

example can be found in the United States. In San Francisco, Sutter Health with the support of the University of California - Berkeley, are successfully implementing lean with impressive results (Feng and Tommelein, 2009; Chambers, 2010; Kagioglou and Tzortzopoulos, 2010; Lichtig, 2010). The case illustrates a partial lean implementation, at a hybrid process level, of the planning and design of healthcare infrastructure. Table IV shows the key emergent themes the healthcare organization.

Healthcare organisation	Observations
Improving the process cycle time	The lean framework deployed supported to reduce the process cycle time by 18%.
Restructuring the information flow	MCDA and QFD supported to restructure the information process and take into account the lessons learned from past schemes, as well as integrate the voice of the customers, and make rational decisions.
Improving the process transparency	The lean planning and design processes implemented were agreed by the stakeholders and enhanced its transparency; it enabled easier tracking of projects at any time.
Reducing the planning and design cost	6.5% of total cost was saved. By speeding up the process, elimination reworks, focusing the public consultation and having les capital tied-in.
Improving the communication between the stakeholder group	Lack of process ownership and lack of effective communication between the partners. The lean techniques supported to encourage cross-functionality between estates, planners, primary care, clinicians and architects.
Improving the fitness for purpose	The premises infrastructure was planned and designed with the customer in mind from the project starts, which improved the final product fitness for purpose.
Embarking in a continuous improvement journey	Lean enable to set up some internal benchmark and key metrics in term of cycle time, quality (fitness for purpose) that is now used for continuous improvement purposes.

Table IV: Case Two – The Healthcare Organisation: Key Emergent Themes

It was established that lean thinking provided a lens to study the problem (inefficient and ineffective infrastructure development) as well as providing the theory to analyse root cause and the process bottlenecks. Finally, the solutions developed were inspired from the lean techniques heritage to solve these problems: MDCA, QFD, and benchmarking in order to introduce controlled process change and improvement. This second case complements the first to develop a deeper understanding of the phenomenon of lean implementation.

5. Discussion

To provide a clear structure for the discussion this section has been arranged around the research questions. Returning to the research objectives, firstly "*how does a company use the Lean ideology to achieve their strategic objectives?" (RQ1)*

Sweeney and Carter (1990) and Thun *et al* (2010) believe that lean is a necessary step to improve competitiveness. The findings at the food Company support this assertion. This is clearly corroborated by the Healthcare case, as the partial lean implementation is used to enhance the planning and design of healthcare construction, by improving the efficiency (speed) and the effectiveness (fitness for purpose) to satisfy the local demand, through streamlining and optimizing key decision making processes. Lean provided the means to achieve the healthcare organization strategic objectives: improving service quality and accessibility by modernizing the network of infrastructures. Arguably the most documented strategic use of lean is the use of the philosophy and techniques to improve operational efficiency. The use of techniques synonymous with lean facilitated a broad range of operational improvements at the food Company including the 40 per cent reduction in wastage figures at Site Two, the reduction in working capital of £600,000 at Site One. Lean implementation clearly facilitated improvements in operational efficiency. This fits with the argument put forward by Olhager and West (2002) that lean is a system for improving collective efficiency of units and tiers of supply through the value chain.

The lean literature highlights one other strategic use for the ideology: the framework it provides for implementing a change strategy. White *et al* (2009) suggest that the correct sequence is best for operational gains. Brandenberg and Ellinger (2002), in their review of the human resource development issues, suggest those companies implementing lean effectively plan for proactive organizational learning. The food Company used the underlying lean philosophies (waste elimination, continuous improvement, employee involvement and autonomy) to structure their change strategy. In the healthcare organization the lean framework developed for the pilot project became an opportunity to create, structure and manage changes and improvements by challenging the status-quo. The food Company facilitated a change strategy with sympathy to their specific needs by using situational specific techniques such as Kanban control in the mincemeat department. Frohlich and Westbrook (2001) argue that the process of formulating and implementing strategy should link with the wider supply chain to increase the so-called ‘arc of integration’ – ultimately connecting both upstream and downstream sides. This argument is also relevant for the Healthcare case, where the lean implementation should spread throughout the next process steps, the construction and management of the infrastructure, as well as with the external partners (architects, contractors, and

planners) to achieve even better outcomes. The central thesis here is the wider the arc the higher the level of performance. This premise is not yet considered by the Company or the Healthcare organization.

Parallels can be drawn between the literature and the case findings here, as proposed at the end of the literature review there are three principal uses of lean in a strategic sense (i. gain a strategic competitive advantage; ii. improve operational efficiency; iii. provide a framework to implement a change strategy) and from our research it is clear these usages are not independent of one another - they are interlinked and might be said to be conscious throughout the organisation. Continuing this observation further, not only does the ideology facilitate a change strategy when identified as necessary, it also presents an essential step in organizational development in order to remain competitive. We suggest that the use of lean in organizations presents an iterative process (defined here as repeated application) as in the context of ascertaining strategic objectives: i) organizations adopt the Lean philosophy as a means of obtaining strategic objectives; ii) in our specific cases the Lean ideology encompasses the dominant manufacturing and construction practices. It could therefore be argued that any relevant strategic objective must be based upon the Lean philosophy, i.e. the use of established best practice for the specific context.

Is partial implementation a deterioration of the true philosophy behind Lean and its operational impact? (RQ 2)

From some of the original literature on lean there are two prevailing arguments with regards to the motivation for implementation: i) the motivation for implementation comes from internal desires and objectives within the organization (see Safayeni *et al*, 1991); and ii) implementation is a necessity to remain competitive and is driven by external factors, especially the market or competition (Harber *et al*, 1990). Within the food Company, the motivation for implementation was twofold: i) an internal organizational decision to facilitate strategic objectives and improve efficiency; and ii) the desire to remain competitive within the market, interpreted as external motivation. Within the Healthcare organization, these two motivations could also be attributed to the rational for introducing lean thinking: i) internally - to speed up the entire cycle time, as up to 12 years to completion cannot equal fitness for purpose; and ii) externally – to satisfy the local population who required an inclusive and transparent decision making processes. The findings of this paper show that the

motivational orientation is not exclusive and is, more often than not, a combination of internal and external influences.

The food Company's managers saw lean as a means of improving operational efficiency, reducing wastage, and verifying the need for machine overhauls, all linked to lean benefits (c.f. Olhager and West, 2002; Thun *et al*, 2010). The implementation of techniques on the shop floor was based on practical trial periods rather than theoretical prescriptions deriving from the literature. This helps in demonstrating improvements and acceptance, avoiding the "not invented here" syndrome. Both shop floor and managerial employees were generally very positive; as Safayeni *et al* (1991) said is often the case, the belief that lean was a 'good thing' was certainly present. The different lean techniques introduced within the healthcare organization were well accepted by the large group of stakeholders, who could appreciate the results. For instance, the benchmarking activities followed by the internal assessment to evaluate the innovations and performances gaps and set up the continuous improvement activities were positively received by the cross-functional teams (c.f. Singh and Singh, 2013).

An area of debate within the lean literature remains around what is the "best" method for implementation. As previously stated, the literature shows a dichotomy of argument: that i) organizations adopting lean must holistically embrace both the philosophies and techniques in order to gain any true benefit; versus ii) that any level of progressive adoption will provide benefits. Assessing both organizations adoption process, the second of these perspectives holds. Both the Company and the Healthcare organization adopted a progressive, at times iterative, approach to lean implementation through a transitional period during which the organizations' management and other stakeholders could adjust, learning the new techniques and implementing them. They both appeared to be moving towards a more holistic adoption of lean but, in the interim, a partial adoption of techniques appeared to strongly facilitate the acceptance of the underlying philosophy.

The distinction between these two options was not necessarily a conscious choice by the organizations. We conclude that there are a number of factors that facilitate, or impede, an organization's adoption of lean, many of which are external. This questions the current literature on levels of implementation which often infers that certain restrictions reduce the effectiveness of key implementation stages. As the cases here have shown, some stages can be leapfrogged without fully completing

preceding ones, and still to good effect. As a result, rather than questioning partial adoption and a step-wise adoption of lean, there is in reality more of a balance and appropriation whereby organizations need to remove restrictions and blocks in order to progress towards full lean adoption. This idea is represented in Figure 4, using the restrictions identified.

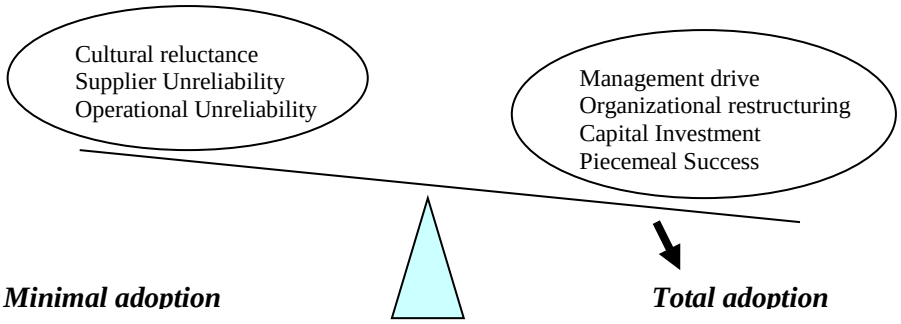

Figure 4: The balance between Total and Partial adoption

The cases demonstrate a partial lean implementation based upon the model of Safayeni *et al* (1991) who outlined four levels in the implementation. These being associated with the maturity level and the scope of the implementation: Education, Pilot Project, Modified and Total. Therefore, from the case studies presented here the healthcare organization is at the Pilot Project level and the manufacturing Company at the Modified level. Both organisations are therefore, by definition, within the Partial Implementation stage of lean. See Figure 5.

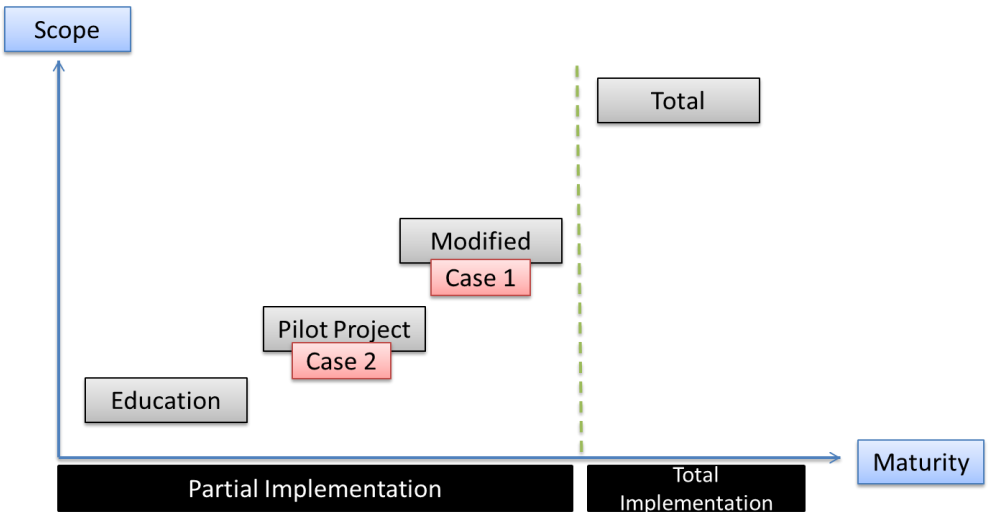

Figure 5: Case Companies in Context (adapted from Safayeni, *et al*., 1991)

Does partial adoption of the Lean philosophy inhibit the potential of the company? (RQ3)

Lean aims for the complete elimination of waste (Mistry, 2005; Papadopoulou & Özbayrak, 2005; Salaheldin, 2005). Attempting this too quickly is a very risky operations strategy, particularly where the reliability of manufacturing equipment is far from 100 per cent. With a seasonal demand for products, the food Company was affected by anything from the weather to changing taste preferences. As a result some level of finished stock was required to satisfy unexpected or higher than average demand, and also to ensure a sensible management of capacity. A trade-off from the pure lean philosophy is clearly essential in order to maintain operations and ultimately meet consumer demand. Buvik and Halskau (2001), in their paper on relationships and efficiency in the value chain, agree with this point (c.f. Panizzolo, 1998).

A second area for waste elimination is that of Work in Progress (WIP). Lean challenges the need for WIP buffering by encouraging a pull system of control. The food Company tried to implement a pull system of control. However, lead times involved in product preparation negated the complete and absolute use of a pull system. In the preserves department each stage in the process is not completely independent from the next. The Company was unable to adopt the total philosophy due to practical restrictions. Operational restrictions therefore prevented full adoption of a waste elimination programme. Demeter and Matyusz (2011) and Standard and Davis (1999), however, highlight that reducing inventory and WIP are not explicit goals of lean: "it is a consequence of reducing variability and inventory reduction in a beneficial consequence" (Standard and Davis, 1999:137). The food Company adopted the philosophy entirely and yet has not received the maximum operational benefit of waste elimination, due to operational choices designed to reduce the risk involved in 100 per cent waste elimination. Full lean may not always provide the best strategy (for example, length of lead times) and therefore partial implementation of an elimination of waste programme is justified under certain conditions. This conclusion is reiterated by Mistry (2005) and McLachlin (1997), who both highlighted lead times as a contributing determinant when considering an organization's suitability for lean adoption.

Moreover, with the healthcare organization, one can triangulate the partial lean phenomenon. It was found that by partially implementing lean, variability within the

process and the risks involved could be reduced and mitigated by supporting rational and sound decision making processes. Moreover, it was established that lean is environmentally dependent - the culture, maturity level and the core activities greatly influence the shape of the implementation. Although the authors recognise that a full lean implementation can generate great benefits, it would have been too radical to fully implement lean throughout the entire healthcare infrastructure development process. Involving all partners simultaneously, where the risk of failure would have been substantial, was deemed too perilous. However, it was relevant to have an iterative improvement process focused on the bottlenecks as the theory of constraints suggests. Therefore, it is believed that a partial tailored lean implementation can be appropriate and successful, stimulating the organization.

Harber *et al* (1990:21) identified that many of the organizational philosophies and techniques synonymous with lean were "readily available for many years under the umbrella of industrial relations". As such, it appears that lean encompasses many ideas based within best practice. The argument that partial adoption of lean will inhibit long term potential (Voss and Harrison, 1987) of an organization is therefore questionable. Certainly Thun *et al* (2010) believe that a fuller implementation of the practices of the Toyota Production System demonstrate superior perceived performance in terms of the key performance criteria of operations: time, cost, quality and flexibility.

6. Conclusions

We suggest that the issue of conscious and unconscious lean usage and implementation is an emerging, iterative, development. As such we propose that there are some parallels with the change management literature that engages in a debate about the extent of planned and emergent change within any organisation (see Bamford and Forrester, 2003); for example, organisations strive to achieve best value and efficiency and lean can provide a useful mechanism/framework to provide this. We propose that lean is a continuous improvement initiative that progresses over a period of time using a number of incremental, iterative changes. Concurrently the organisation will being going through a repeating cycle of change, i.e. planned, emergent, planned, emergent, etc. This, we suggest, syncs with the cycle of adoption of lean techniques (such as JIT, etc.) over a period of time through a repeating cycle

of conscious, unconscious, conscious, implementation. Figure 6 shows a conceptual representation of this embryonic idea.

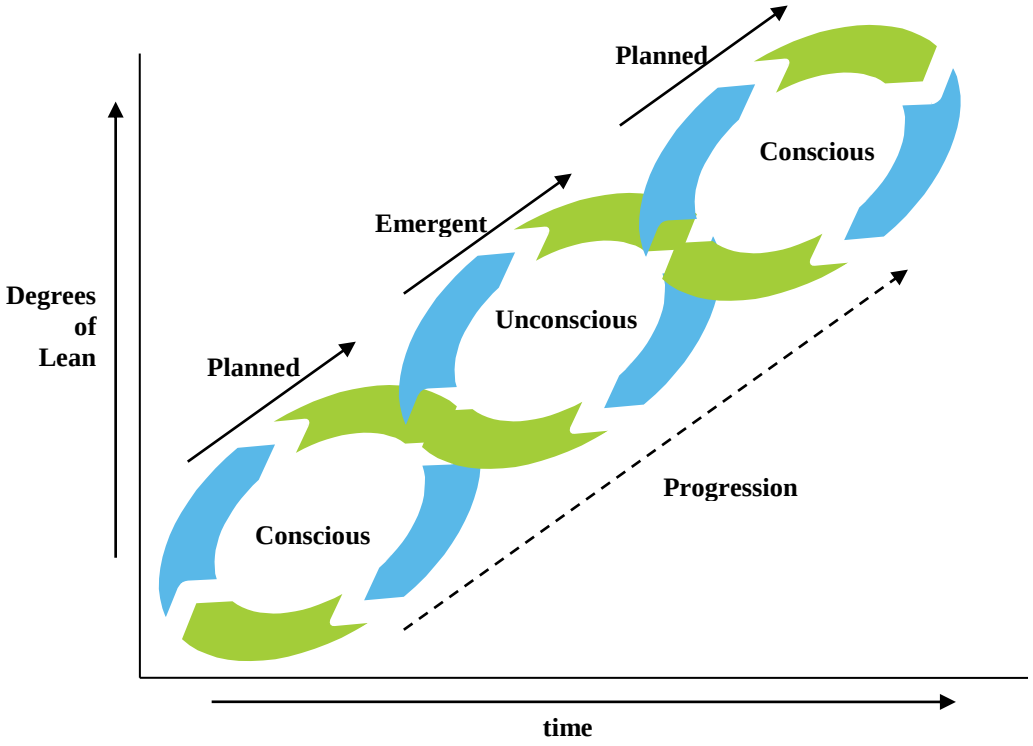

Figure 6: Degrees and Cycles of Lean Implementation

This emergent model inspires our first suggested area for further research; an exploration of the preposition "the implementation of lean techniques and philosophy, as it has spread from its initial core in automotive production, continues to be largely an unconscious adoption by organizations as they seek to improve performance and eliminate waste from processes". If this was established as a hypothesis and proven through research, the traditional literature on the necessity for complete lean implementation could be directly challenged. A second area for research could be focused upon the proposed restrictions to lean philosophy implementation. The research could be extended to the cost of overcoming such restraints to add a quantitative measure to the findings.

We have provided an extensive review of the literature and whilst the main reference used within our research to a "total" implementation, Safayeni *et al* (1991), could be considered dated and is framed in manufacturing, it was extremely useful as a sound conceptual base for exploring and shaping our ideas. Furthermore, that the manufacturing origins and context are necessary in terms of development. Also, in the literature review the ad-hoc nature of implementation is highlighted (Bamford,

2011; Fiedler *et al* 1993) and this could suggest that every implementation be considered partial. Nonetheless, we suggest that our review is representative of the available cross-section of literature and that our own conceptual representation (Degrees and Cycles of Lean Implementation) develops this point.

The methodology applied required the collection of research data appropriate and consistent with the perceived outcomes. This research has provided a foundation for future work as defined above. It is acknowledged that further detail regards the research techniques and methodology would have added value, however, word count limitations worked against this. The authors also acknowledge that it is difficult to generalise the results from two case studies, even though they are longitudinal, as they only represent a small proportion of the wide variety of different companies operating in multiple financial and market circumstances (c.f. Klingenberg *et al*, 2013). In addition, the way lean is defined is rather pragmatic, therefore it is suggested that all common process improvement techniques could fall under the umbrella of a lean philosophy. This may well be true and justify the reasons why techniques such as Quality Function Deployment (QFD) which are sometimes used without reference to lean, are in this paper considered as lean techniques. Moreover, we recognize that some more grounded lean techniques such as Kanban, Conwip, Drum-Buffer-Rope, QRM, if implemented, produce very different results from each other.

In summary, the paper is an addition to the knowledge base about the implementation of lean techniques. It is difficult obtaining objective information about the implementation of lean methods - other than perhaps the Japanese firms - and any research knowledge about implementation is valuable. The main contribution of this research is that it has added to the body of knowledge on lean and its implementation, specifically through an exploration of its partial implementation.

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